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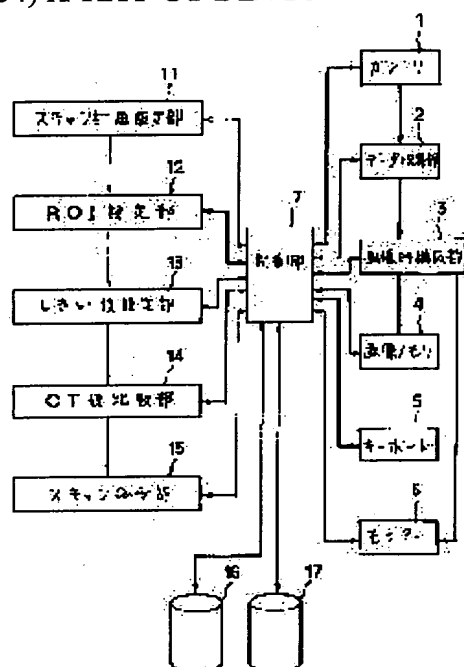
(21)Application number : 04-267628

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(54) X-RAY CT DEVICE



(57)Abstract:

PURPOSE: To provide an X-ray CT device capable of automatically starting or stopping scanning corresponding to a state stained with a contrast medium.

CONSTITUTION: An X-ray CT device is equipped with an ROI setting part 12 setting ROI in a predetermined X-ray image, a threshold value setting part 13 setting the threshold value related to the CT value in the ROI, a CT value comparison part 14 calculating the CT value in the ROI and comparing the calculated CT value with the threshold value with the elapse of time and a scanning command part 15 issuing a command starting or stopping scanning corresponding to the comparison result.

CLAIMS

[Claim(s)]

[Claim 1] The X-ray CT scanner characterized by having the ROI setting section which sets up ROI in a predetermined X-ray picture, the threshold setting section which sets up the threshold about the CT valve in said ROI, a CT valve comparator [with time / said threshold / CT valve / which was calculated while calculating the CT valve in said ROI], and the scanning instruction part which orders initiation or a halt of predetermined of a scan according to said comparison result.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to an X-ray CT scanner, and relates to the X-ray CT scanner which performs a dynamic scan especially.

[0002]

[Description of the Prior Art] Conventionally, in the X-ray CT scanner, the technique called a dynamic scan is performed briskly.

[0003] A dynamic scan is the technique of scanning continuously over predetermined time amount according to the rate of the contrast medium which flows the inside of analyte, after prescribing a contrast medium for the patient.

[0004] Generally the sensibility of the X-ray projection data obtained with the dynamic scan is the highest immediately after pouring a contrast medium into analyte, and it falls with the passage of time after that. Therefore, a scan is usually performed at the so-called "the early stage (early phase)" immediately after pouring in a contrast medium.

[0005] However, recently, it turns out that a useful and characteristic image is comparatively obtained on a diagnosis also in "a late stage (late phase)" not only the early stage immediately after contrast-medium administration but after carrying out predetermined time progress.

[0006] This is because the description is in how to dye a contrast medium according to an organ, a disease class, etc., for example, when a contrast medium is prescribed for the patient in large quantities by diagnosis of the hepatoma, it is reported that a useful image is obtained in a late stage (a "CT diagnostic: [of the hepatoma], especially phase by contrast-medium extensive administration" Japan radiology meeting scientific exhibition, 1992, 3.R52.07, and S239 page).

[0007] The scan in such a late stage is performed by the following procedures.

[0008] First, the scan in an early stage is performed.

[0009] In a stage (suppose that this is called a transition stage on these specifications) after an early stage passes, until it enters at the late next stage, scanning actuation is continued on predetermined X-ray exposure conditions required to supervise the timing which enters at a late stage, and an operator supervises the timing which enters at a late stage, looking at the X-ray picture displayed on the monitor.

[0010] An operator judges whether it entered at the late stage by whether the concentration of the image displayed on the monitor increased.

[0011] Next, if having entered at the late stage is checked by the monitor, the predetermined scan in a late stage will be performed.

[0012]

[Problem(s) to be Solved by the Invention] However, since individual difference is large about the length of a transition stage, it is not easy to predict in advance the timing which enters at a late stage.

[0013] Moreover, since decision whether it entered at the late stage is left to decision of the operator who supervises a monitor, an operator's burden increases.

[0014] Furthermore, since there is dispersion in individual in the density resolution of an operator's eyes, the decision by the operator has a limitation on precision.

[0015] Although these reasons showed on the diagnosis that the image in a late stage was effective, it was difficult to photo the image in a late stage certainly.

[0016] Moreover, after a contrast medium is poured in, by the time it is dyed a predetermined organ, in order to require between a certain degree degree hours, there was a limitation in respect of precision also about catching the timing of the start of an early stage experientially.

[0017] This invention was made in consideration of the situation mentioned above, and aims at offering the X-ray CT scanner which can perform initiation or a halt of a scan automatically according to how depending on which a contrast medium dyes.

[0018]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, as indicated to claim 1, the X-ray CT scanner of this invention The ROI setting section which sets up ROI in a predetermined X-ray picture, and the threshold setting section which sets up the threshold about the CT valve in said ROI, It has with time a CT valve comparator [said threshold / CT valve / which was calculated while calculating the CT valve in said ROI], and the scanning instruction part which orders initiation or a halt of predetermined of a scan according to said comparison result.

[0019]

[Function] According to the X-ray CT scanner of this invention, first, ROI is set up in a predetermined X-ray picture, and, subsequently, the threshold about the CT valve in ROI is set up. Subsequently, as compared with a threshold, initiation or a halt of predetermined of a scan is ordered for the CT valve in ROI according to a comparison result with time.

[0020] In a desirable example, when it is set up in order to catch the late stage to appear after the predetermined time after contrast-medium administration passes, and a CT valve exceeds this threshold, a threshold judges that it entered at the late stage, and starts the scan to a late stage.

[0021]

[Example] Hereafter, the example of the X-ray CT scanner of this invention is explained with reference to an accompanying drawing.

[0022] Drawing 1 shows the X-ray CT scanner of this example with a block diagram.

[0023] The X-ray CT scanner of this example is equipped with the monitor 6 grade which displays the gantry 1 which carried the X-ray tube and the X-ray detector, the data collection section 2 which collects the X-ray projection data from an X-ray detector, the image reconstruction section 3 which reconfigures an image using the collected X-ray projection data, the image memory 4 which stores the reconfigured image, the keyboard 5 which inputs various operational parameters, and the reconfigured image, and is equipped with the control section 7 which controls these further.

[0024] The scanning planned setting section 11 to which the X-ray CT scanner of this example sets a scanning parameter again, The ROI setting section 12 which sets up ROI in a predetermined X-ray picture, and the threshold setting section 13 which sets up the threshold about the CT valve in ROI, It has with time the CT valve comparator [threshold / CT valve / which was calculated while calculating the CT valve in ROI] 14, and the scanning instruction part 15 which orders initiation or a halt of predetermined of a scan according to a comparison result.

[0025] When it is set up in order to catch the late stage to appear after the predetermined time after contrast-medium administration passes, and a CT valve exceeds this threshold, a threshold judges that it entered at the late stage, and starts the scan to a late stage.

[0026] The X-ray CT scanner of this example is equipped with the ROI information storage file 16 which memorizes the location and dimension of ROI which were set up again, and the scanning parameter storage file 17 which memorizes the set-up scanning parameter.

[0027] Drawing 2 is the flow chart which showed the procedure which scans a late stage using the X-ray CT scanner of this example.

[0028] First, the scanning parameter to an early stage, a transition stage, and a late stage is set up using the collected SUKAYANO image.

[0029] A setup of a scanning parameter is performed in the scanning planned setting section 11, and the tube voltage of an X-ray tube, the tube electric current, a sampling period, etc. are set up for every early stage, transition stage, and late stage, respectively.

[0030] Here, the set-up scanning parameter is memorized to the scanning parameter storage file 17.

[0031] The scanning parameter in a transition stage is set up in consideration of a sampling period required to supervise whether it entered at the late stage.

[0032] Subsequently, ROI is set up on an image predetermined in the ROI setting section 12.

[0033] Being able to obtain [and] a predetermined image by performing a single scan, a setup of ROI sets up a part with the imaging effectiveness using a mouse.

[0034] Drawing 3 shows ROI21 set as the predetermined image displayed on the monitor 6.

[0035] Here, the location and dimension of ROI which were set up are memorized to the ROI information storage file 16.

[0036] With reference to drawing 2 , the threshold for detecting the start of a late stage is again set up in the threshold setting section 13 about the CT valve in set-up ROI.

[0037] Drawing 4 takes CT value change in ROI which changes with impregnation of a contrast medium along an axis of abscissa, takes a CT valve along time amount and an axis of ordinate, is shown, also doubles contrast-medium grouting velocity and is shown.

[0038] alpha has shown the threshold so that it may understand by drawing 4 .

[0039] With reference to drawing 2 , the scanning instruction part 15 sends again the control signal which requires initiation of a scan of an early stage to a control section 7 after a setup of a threshold.

[0040] The control section 7 which received this control signal controls these each part so that read-out, a gantry 1, and data collection section 2 grade operate the scanning parameter to an early stage according to this scanning parameter from the scanning parameter storage file 17, and it performs the dynamic scan in an early stage.

[0041] The scanning instruction part 15 sends the control signal which requires initiation of a scan of a transition stage to a control section 7 after termination of the scan in an early stage.

[0042] A control section 7 controls each part for the scanning parameter to a transition stage according to read-out and this scanning parameter from a storage file 17, and performs a monitor scan.

[0043] The CT valve comparator 14 judges whether as compared with the threshold, it exceeded the threshold for the CT valve calculated and calculated [CT valve / in read-out and this ROI] in the location and dimension of ROI from the ROI information storage file 16 during this monitor scan.

[0044] The CT valve comparator 14 requires initiation of a scan of a predetermined signal of the stage when delivery and the scanning instruction part 15 are late of the scanning instruction part 15 at a control section 7, when it judges that the CT valve exceeded the threshold.

[0045] A control section 7 controls each part for the scanning parameter to a late stage according to read-out and this scanning parameter from a storage file 17, and performs the dynamic scan in a late stage.

[0046] As explained above, the X-ray CT scanner of this example can catch automatically the timing which shifts from a transition stage at a late stage by setting up ROI on a predetermined image, considering as a monitor field, and supervising CT value change in this ROI.

[0047] Therefore, dispersion by the difference in an operator is lost and the shift to a late stage can be caught in a high precision.

[0048] Moreover, since it becomes unnecessary for an operator to supervise CT value change, the burden of actuation of the operator of CT inspection is mitigated.

[0049] Moreover, since CT value change can be supervised in a high precision, the need of sampling frequently decreases and an exposed dose decreases.

[0050] In the above-mentioned example, although explained for the dynamic scan, the X-ray CT scanner of this invention is not limited to this dynamic scan, and may be applied to helical scan.

[0051] Moreover, in the above-mentioned example, although the monitor of the threshold in ROI was used for detection of the timing of the start of a late stage, it is not limited to this and you may use for detection of the timing of the start of an early stage.

[0052] Moreover, it constituted from an above-mentioned example so that a scan might be started in the place where the CT valve in ROI exceeded the predetermined threshold, but after exceeding a predetermined threshold, when predetermined time amount has passed, you may constitute so that a scan may be started.

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4, beta is set up as a threshold, and when the CT value in ROI is less than predetermined threshold beta, you may constitute so that a scan may be suspended.

[0054]

[Effect of the Invention] As stated above, the X-ray CT scanner of this invention The ROI setting section which sets up ROI in a predetermined X-ray picture, and the threshold setting section which sets up the threshold about the CT value in said ROI, By having had with time a CT value comparator [said threshold / CT value / which was calculated while calculating the CT value in said ROI], and the scanning instruction part which orders initiation or a halt of predetermined of a scan according to said comparison result According to how depending on which a contrast medium dyes, initiation or a halt of a scan can be performed automatically.

TECHNICAL FIELD

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TECHNICAL PROBLEM

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram of the X-ray CT scanner of this example.

[Drawing 2] The flow chart which showed the procedure of performing the scan in a late stage automatically using the X-ray CT scanner of this example.

[Drawing 3] Drawing having shown ROI set as the image on a monitor.

[Drawing 4] The graph which showed CT value change in ROI.

[Description of Notations]

7 Control Section

11 Scanning Planned Setting Section

12 ROI Setting Section

13 Threshold Setting Section

14 CT Valve Comparator

15 Scanning Instruction Part

16 ROI Information Storage File

17 Scanning Parameter Storage File

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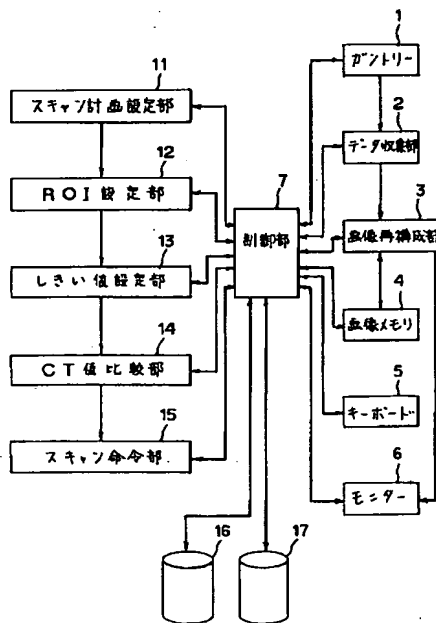
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(54)【発明の名称】 X線CT装置

(57)【要約】

【目的】造影剤の染まり方に応じてスキャンの開始あるいは停止を自動的に行うことができるX線CT装置を提供する。

【構成】本発明のX線CT装置は、所定のX線画像内にROIを設定するROI設定部12と、ROI内のCT値に関するしきい値を設定するしきい値設定部13と、ROI内のCT値を計算するとともに計算されたCT値を経時的にしきい値と比較するCT値比較部14と、比較結果に応じて所定のスキャンの開始あるいは停止を命令するスキャン命令部15とを備える。



【特許請求の範囲】

【請求項1】 所定のX線画像内にROIを設定するROI設定部と、前記ROI内のCT値に関するしきい値を設定するしきい値設定部と、前記ROI内のCT値を計算するとともに計算されたCT値を経時的に前記しきい値と比較するCT値比較部と、前記比較結果に応じて所定のスキヤンの開始あるいは停止を命令するスキヤン命令部とを備えたことを特徴とするX線CT装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、X線CT装置に係り、特に、ダイナミックスキヤンを行うX線CT装置に関する。

【0002】

【従来の技術】従来、X線CT装置では、ダイナミックスキヤンと呼ばれる撮影法が盛んに行われている。

【0003】ダイナミックスキヤンは、造影剤を投与した後、被検体内を流れる造影剤の速度に応じて、所定の時間にわたって連続的にスキヤンを行う手法である。

【0004】ダイナミックスキヤンで得られたX線投影データの感度は、一般的には、造影剤を被検体に注入した直後が最も高く、その後、時間の経過とともに低下する。したがって、普通、造影剤を注入した直後のいわゆる“早い時期(early phase)”にスキヤンが行われる。

【0005】ところが、最近では、造影剤投与直後の早い時期のみならず、所定時間経過した後の比較的“遅い時期(late phase)”においても診断上有用かつ特徴的な像が得られることがわかっている。

【0006】これは、臓器、疾患種類等によって造影剤の染まり方に特徴があるためで、例えば、肝細胞癌の診断で造影剤を大量に投与した場合、遅い時期において有用な像が得られることが報告されている(「造影剤大量投与による肝細胞癌のCT診断：特にphaseについて」、日本放射線学会学術発表会、1992年、3.R52.07,5239頁)。

【0007】このような遅い時期におけるスキヤンは、次のような手順で行われる。

【0008】まず、早い時期におけるスキヤンを行う。

【0009】早い時期が経過した後、次の遅い時期に入るまでの時期(これを本明細書では遷移時期と呼ぶこととする)においては、遅い時期に入るタイミングを監視するのに必要な所定のX線曝射条件でスキヤン動作を継続し、オペレーターは、モニターに表示されたX線画像を見ながら遅い時期に入るタイミングを監視する。

【0010】遅い時期に入ったかどうかは、モニターに表示された画像の濃度が増加したかどうかによってオペレーターが判断する。

【0011】次に、遅い時期に入ったことがモニターで確認されたならば、遅い時期における所定のスキヤンを行う。

【0012】

【発明が解決しようとする課題】しかしながら、遷移時期の長さについては個人差が大きいため、遅い時期に入るタイミングを事前に予測することは容易ではない。

【0013】また、遅い時期に入ったかどうかの判断は、モニターを監視するオペレーターの判断に委ねられるため、オペレーターの負担が増大する。

【0014】さらに、オペレーターの目の濃度分解能には個人のばらつきがあるため、オペレーターによる判断は、精度上、限界がある。

【0015】これらの理由から、遅い時期における像が診断上有効であるとわかっているにもかかわらず、遅い時期における像を確実に撮影することが困難であった。

【0016】また、造影剤が注入されてから所定の臓器に染まるまでにはある程度時間を要するため、早い時期の立上りのタイミングを経験的に捕らえることについても、精度の点で限界があった。

【0017】本発明は、上述した事情を考慮してなされたもので、造影剤の染まり方に応じてスキヤンの開始あるいは停止を自動的に行うことができるX線CT装置を提供することを目的とする。

【0018】

【課題を解決するための手段】上記目的を達成するため、本発明のX線CT装置は請求項1に記載したように、所定のX線画像内にROIを設定するROI設定部と、前記ROI内のCT値に関するしきい値を設定するしきい値設定部と、前記ROI内のCT値を計算するとともに計算されたCT値を経時的に前記しきい値と比較するCT値比較部と、前記比較結果に応じて所定のスキヤンの開始あるいは停止を命令するスキヤン命令部とを備えたものである。

【0019】

【作用】本発明のX線CT装置によれば、まず、所定のX線画像内にROIを設定し、次いで、ROI内のCT値に関するしきい値を設定する。次いで、ROI内のCT値を経時的にしきい値と比較し、比較結果に応じて所定のスキヤンの開始あるいは停止を命令する。

【0020】好ましい実施例においては、しきい値は、造影剤投与後所定時間が経過した後現れる遅い時期を捕捉するために設定され、CT値がこのしきい値を上回ったとき、遅い時期に入ったと判断し、遅い時期に対するスキヤンを開始する。

【0021】

【実施例】以下、本発明のX線CT装置の実施例について、添付図面を参照して説明する。

【0022】図1は、本実施例のX線CT装置をブロック図で示したものである。

【0023】本実施例のX線CT装置は、X線管およびX線検出器を搭載したガントリー1、X線検出器からのX線投影データを収集するデータ収集部2、収集された

X線投影データを用いて画像を再構成する画像再構成部3、再構成された画像を格納する画像メモリ4、さまざまな動作パラメータを入力するキーボード5、再構成された画像を表示するモニター6等を備え、さらにこれらを制御する制御部7を備える。

【0024】本実施例のX線CT装置はまた、スキャンパラメータを設定するスキャン計画設定部11と、所定のX線画像内にROIを設定するROI設定部12と、ROI内のCT値に関するしきい値を設定するしきい値設定部13と、ROI内のCT値を計算するとともに計算されたCT値を経時的にしきい値と比較するCT値比較部14と、比較結果に応じて所定のスキャンの開始あるいは停止を命令するスキャン命令部15とを備える。

【0025】しきい値は、造影剤投与後所定時間が経過した後に現れる遅い時期を捕捉するために設定され、CT値がこのしきい値を上回ったとき、遅い時期に入ったと判断し、遅い時期に対するスキャンを開始する。

【0026】本実施例のX線CT装置はまた、設定されたROIの位置および寸法を記憶するROI情報記憶ファイル16と、設定されたスキャンパラメータを記憶するスキャンパラメータ記憶ファイル17とを備える。

【0027】図2は、本実施例のX線CT装置を用いて遅い時期のスキャンを行う手順を示したフローチャートである。

【0028】まず、収集されたスキャン像を用いて、早い時期、遷移時期および遅い時期に対するスキャンパラメータを設定する。

【0029】スキャンパラメータの設定は、スキャン計画設定部11で行い、X線管の管電圧、管電流、サンプリング間隔等を、早い時期、遷移時期および遅い時期ごとにそれぞれ設定する。

【0030】ここで、設定されたスキャンパラメータは、スキャンパラメータ記憶ファイル17に記憶しておく。

【0031】遷移時期におけるスキャンパラメータは、遅い時期に入ったかどうかを監視するのに必要なサンプリング周期を考慮して設定する。

【0032】次いで、ROI設定部12で所定の画像上にROIを設定する。

【0033】所定の画像は、シングルスキャンを行うことによって得ることができ、また、ROIの設定は、造影効果のある部位を例えばマウスを用いて設定する。

【0034】図3は、モニター6上に表示された所定の画像に設定されたROI21を示したものである。

【0035】ここで、設定されたROIの位置および寸法は、ROI情報記憶ファイル16に記憶しておく。

【0036】再び図2を参照して、設定したROI内のCT値に関し、遅い時期の立上りを検出するためのしきい値をしきい値設定部13で設定する。

【0037】図4は、造影剤の注入に伴って変化するROI内のCT値の変化を横軸に時間、縦軸にCT値をとって示したものであり、造影剤注入速度も合わせて示してある。

【0038】図4でわかるように、しきい値は α で示してある。

【0039】再び図2を参照して、しきい値の設定後、スキャン命令部15は、早い時期のスキャンの開始を要求する制御信号を制御部7に送る。

【0040】この制御信号を受けた制御部7は、早い時期に対するスキャンパラメータをスキャンパラメータ記憶ファイル17から読出し、ガントリー1、データ収集部2等がこのスキャンパラメータにしたがって動作するようにこれら各部を制御し、早い時期におけるダイナミックスキャンを行う。

【0041】早い時期におけるスキャンの終了後、スキャン命令部15は、遷移時期のスキャンの開始を要求する制御信号を制御部7に送る。

【0042】制御部7は、遷移時期に対するスキャンパラメータを記憶ファイル17から読出し、このスキャンパラメータにしたがって各部を制御し、モニタースキャンを行う。

【0043】このモニタースキャンの間、CT値比較部14は、ROI情報記憶ファイル16からROIの位置および寸法を読出し、このROI内のCT値を計算し、計算されたCT値をしきい値と比較し、しきい値を上回ったかどうかを判断する。

【0044】CT値比較部14は、CT値がしきい値を上回ったと判断したとき、スキャン命令部15に所定の信号を送り、スキャン命令部15は、遅い時期のスキャンの開始を制御部7に要求する。

【0045】制御部7は、遅い時期に対するスキャンパラメータを記憶ファイル17から読出し、このスキャンパラメータにしたがって各部を制御し、遅い時期におけるダイナミックスキャンを行う。

【0046】以上説明したように、本実施例のX線CT装置は、所定の画像上にROIを設定して監視領域とし、このROI内のCT値の変化を監視することによって、遷移時期から遅い時期に移行するタイミングを自動的に捕捉することができる。

【0047】そのため、オペレーターの違いによるばらつきがなくなり、遅い時期への移行を高い精度で捕捉することができる。

【0048】また、CT値の変化をオペレーターが監視する必要がなくなるので、CT検査のオペレーターの操作の負担が軽減される。

【0049】また、CT値の変化を高い精度で監視することができるので、頻繁にサンプリングする必要が少なくなり、被曝線量が減少する。

【0050】上述の実施例では、ダイナミックスキャン

を対象として説明したが、本発明のX線CT装置はかかるダイナミックスキャンに限定されるものではなく、例えばヘリカルスキャンに適用してもよい。

【0051】また、上述の実施例では、ROI内のしきい値の監視を遅い時期の立上りのタイミングの検出に用いたが、これに限定されるものではなく、早い時期の立上りのタイミングの検出に用いてもよい。

【0052】また、上述の実施例では、ROI内のCT値が所定のしきい値を越えたところでスキャンを開始するように構成したが、所定のしきい値を越えてから所定の時間が経過したときにスキャンを開始するように構成してもよい。

【0053】また、上述の実施例では、ROI内のCT値が所定のしきい値を越えたところでスキャンを開始するように構成したが、図4に示すようにしきい値として β を設定しておき、ROI内のCT値が所定のしきい値 β を下回ったときにスキャンを停止するように構成してもよい。

【0054】

【発明の効果】以上述べたように、本発明のX線CT装置は、所定のX線画像内にROIを設定するROI設定部と、前記ROI内のCT値に関するしきい値を設定するしきい値設定部と、前記ROI内のCT値を計算する*

*とともに計算されたCT値を経時的に前記しきい値と比較するCT値比較部と、前記比較結果に応じて所定のスキャンの開始あるいは停止を命令するスキャン命令部とを備えたことにより、造影剤の染まり方に応じてスキャンの開始あるいは停止を自動的に行うことができる。

【図面の簡単な説明】

【図1】本実施例のX線CT装置のブロック図。

【図2】本実施例のX線CT装置を用いて遅い時期におけるスキャンを自動的に行う手順を示したフローチャート。

【図3】モニター上の画像に設定されたROIを示した図。

【図4】ROI内のCT値の変化を示したグラフ。

【符号の説明】

7 制御部

11 スキャン計画設定部

12 ROI設定部

13 しきい値設定部

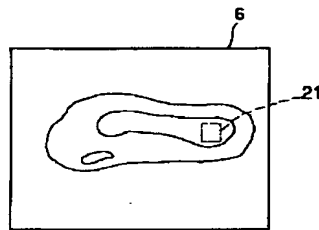
14 CT値比較部

15 スキャン命令部

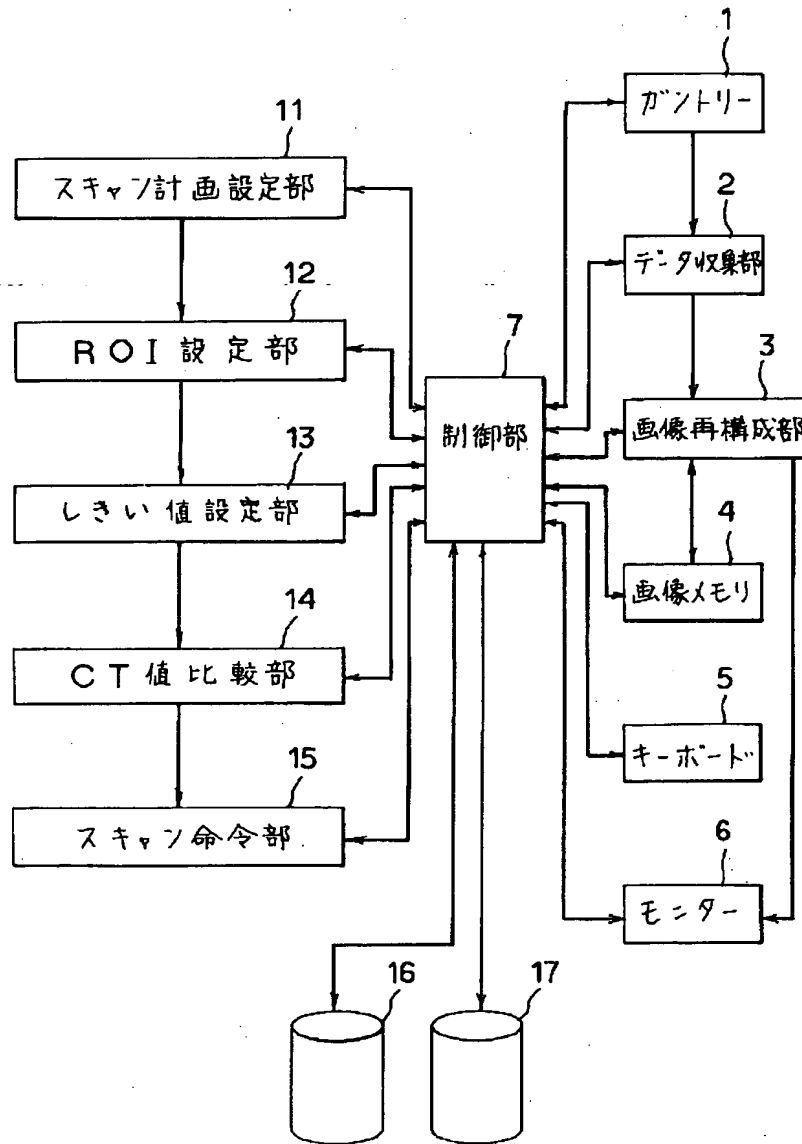
16 ROI情報記憶ファイル

17 スキャンパラメーター記憶ファイル

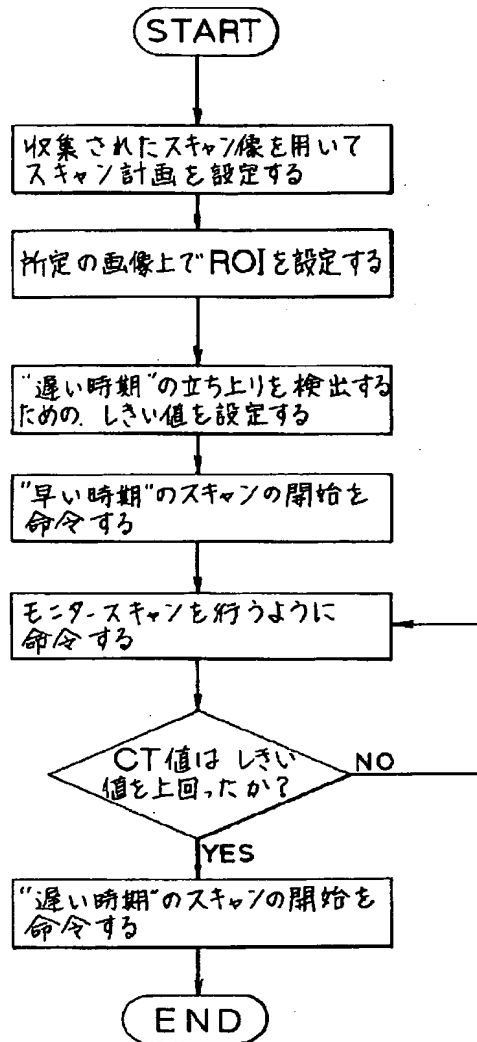
【図3】



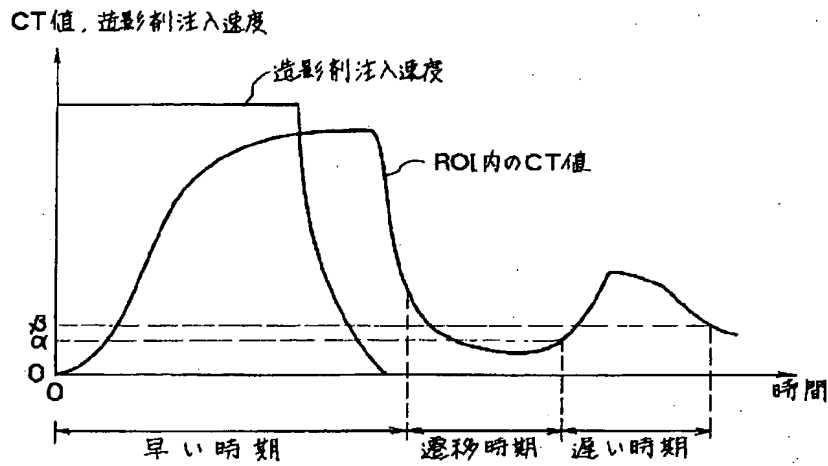
【図1】



【図2】



【図4】



【手続補正書】

【提出日】平成4年11月10日

【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】0028

【補正方法】変更

【補正内容】

【0028】まず、収集されたスキャン像を用いて、スキャン位置を設定する。また、早い時期、遷移時間および遅い時期に対するスキャンパラメータを設定する。

【手続補正2】

【補正対象書類名】図面

【補正対象項目名】図2

【補正方法】変更

【補正内容】

【図2】

